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THE WORLD'S FOOD RESOURCES

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The immediate prompting for this article was the publication recently of a book of the same title¹ by Professor J. Russell Smith. These paragraphs do not, however, purport to conform to the usual book review, nor are they intended as a criticism of that volume. Rather it is proposed to suggest some considerations, having a bearing on the problem of the world's present and future food supply, that the writer thinks need to be taken into account before one may accept *in toto* the roseate future that Dr. Smith paints.

"THE WORLD'S FOOD RESOURCES," BY J. RUSSELL SMITH

It should be said at the outset that "The World's Food Resources" is a very valuable contribution to geographic and economic literature. In it are summarized exhaustively all the pertinent facts in regard to the varied materials that are serving, and may serve, to furnish nourishment for the human race, and there are discussed the adequacy and extensibility of such auxiliaries, like the nature and number of beasts of burden, that are a necessary part of the equipment for most food production. The book is very entertainingly written, and its material is organized even better than that on the same subjects in the author's earlier volume on "Industrial and Commercial Geography," from which considerable portions have been abstracted and fitted into the new book. Certain *lacunae* in the former book have been filled in, and as a whole the new work presents a very complete inventory and analysis of the wide field its title indicates.

If any fault is to be found, it is that Dr. Smith has not provided us with nearly as many references as he might have done and that he does not cite in full those that he does give, for example one to the *Manufacturer's Record* on pages 321 and 322. That the author has carefully gone over the voluminous source material on his subject is quite evident. It would have been more helpful if he had culled out for us the best of this and thus spared the reader the necessity of making an arduous search when additional or original information is wanted on a given point.

PRESENT AND FUTURE SUFFICIENCY OF WORLD'S FOOD SUPPLY

The writer, having now conformed, at least in part, to the requirements of a review, may be permitted to revert to the particular phase of the subject which it is proposed to enlarge upon in this article and to consider it from a different angle. That is the question of how amply and how well

¹ J. Russell Smith: *The World's Food Resources*. 634 pp.; maps, diagrs., ill. Henry Holt & Co., New York, 1919. \$3.50. 8½ x 6 inches.

(in richness and variety) the world can supply food to present and future human populations. Dr. Smith's position, maintained through all his pages, is well indicated by his beginning of Chapter VIII on "Meat, Men, and Land," where he writes: "Perhaps some reader of this book, seeing statements of the great and in some cases almost indefinite possibilities of increase in breadstuffs and bread substitutes, has come to the conclusion that the author is an incorrigible optimist, touched perhaps with unreason." It is not quite so bad as that, but it should be said that Dr. Smith's statements in regard to the indefinite extensibility of the supply of food materials, while entirely warranted by the facts as he presents them, must nevertheless be accepted with a number of reservations, the need for which the incautious reader will not perhaps perceive, because of the presence of positive sentences like "Agricultural overproduction, not famine, is the problem of thousands and thousands of American farmers" (p. 157). On the other hand it is only fair to say that these limiting factors are suggested every here and there through the pages of "The World's Food Resources," but they are never made emphatic, and what is hid in their shadows may easily be overlooked in the genial sunshine which floods by far the major portion of the pages.

MEANS OF EXPANDING THE FOOD SUPPLY

Expansion of the world's food supply, in order to feed the present human population more adequately or to provide for future greater numbers, may be possible by a number of means. These can be concisely summarized under the following heads:

(1) *Geographical extension of the areas of food production by:*

(a) Occupation of lands adapted to crop or animal production which are as yet inaccessible or only sparsely peopled or inefficiently used, and by swamp drainage and desert land irrigation.

(b) Utilization of lands now too cold or too dry for growth of crops by development of new varieties of food plants that can survive these hard conditions.

(c) Recovering for food production lands now used to grow crops the yields of which are devoted to the arts and industries.

(d) Recourse in greater measure than now to the seas for food.

(2) *Increasing yields per acre by:*

(a) Plant breeding to develop varieties giving higher yields at no greater labor cost.

(b) Substitution of plants giving high return for those now cultivated giving comparatively meager yields.

(c) Dependence on perennial and more certain tree crops instead of so largely on difficultly reared annuals.

(d) Intensifying agriculture by expending more human effort per acre than now.

(3) *New inventions and discoveries*, as:

(a) More complete utilization of crop produced, as by ensilage of corn for cattle feeding or using cottonseed for edible oils.

(b) Utilizing mechanical energy to make possible greater yields per unit of human effort, as by farm tractor.

(c) Improvement of transportation facilities and devices to make all areas available for the crops for which they are best adapted, as by refrigeration to make possible greater supplies of tropical fruits.

(d) Increased volume and quality of fertilizer supply by recourse to new sources, as nitrogen from air through electrical power.

(e) Improved methods of culture and seed selection so that without greater effort higher yields are obtained, as by terrace plowing to conserve rainfall and soil, by spraying fruit, etc.

(f) More general and more efficient storage and better preserving methods so that perishable commodities can be kept for long periods, as by dehydrating vegetables.

(g) Better systems of distribution to prevent the wastes due to so-called overproduction, as by eliminating such procedure as shipping green produce from area of production first to central-market middleman, then back to retail area which is in region of original production.

This is an impressive list of possibilities and a quite reassuring one when the vistas opened up by even a single item from among the various sub-heads are considered. Just because the prospect is so alluring, however, it is worth while to pause and remember that many of these possibilities have long been open but that mankind has nevertheless in places and at times experienced the pangs of hunger and that, while famines have not oppressed the rich and sparsely populated Western world very severely in the years preceding the world war, starvation has been the fate of millions almost every year elsewhere, for example in India and China. Why should this be so?

THE SMALL MARGIN OF PRODUCTION OVER CONSUMPTION

Because, first of all, the margin of food production over food consumption in any one year is very narrow. As measured by excess of exports over imports the wheat crop, which of food materials has the most important place in international trade, shows a surplus in normal years (before the war) of a little over 1 per cent of the total production, only 44,000,000 bushels remaining as a probable carry over from all the 3,823,000,000 bushels grown.² Years of high yield of wheat in one area are in general offset by a partial or complete failure in other important producing areas; thus the Argentine crop was practically a failure in 1917 owing to drought, while in the United States there was an exceptionally good crop both in

² G. B. Roorbach: *The World's Food Supply*, *Annals Amer. Acad. of Polit. and Soc. Sci.*, No. 163, Vol. 74, November, 1917, pp. 1-33; reference on p. 9.

1914 and 1915. Even if there should be a succession of good years in all important growing areas, no provision exists for carrying over the surplus into the lean years that must follow. Any large excess of production of so staple a commodity as wheat simply brings about an automatic reduction in the price over that period, with the result that some of the normally underfed groups of the world's population are able to satisfy their cravings more fully. Ancient Egypt prospered for thousands of years with plenty of food always, it seems, for even the humblest slave, apparently because of the collection of taxes *in kind* and their storing in the national granaries against the deficiencies of succeeding years when the life-giving Nile flood might not rise to its average level. The story of Joseph is the record of how greatly this political economy of the agricultural Egyptians impressed the shepherd nomads, who could make no such provision for lean years.

PREVALENT DEPENDENCE ON HOME PRODUCTION

Wheat is exceptional in that it enters so largely into international trade. Most of the food produced in the world is consumed at home and very largely in the immediate district where it is grown. In bushels, potatoes, in food value, rice much exceed the total production of wheat, but both serve almost exclusively only to feed the peoples who grow them. Corn, another great food, likewise plays little part in feeding alien nationalities, except that in times past, and again recently, much of the large United States crop goes abroad in the form of the elaborated product, pork. Meat from foreign shores, if dairy products be excepted, is of little significance in the rationing of nations. All the variety and vast bulk of perishable foods move only short distances from their sources. The ancient success of Egypt was due to the fact that in the simple life of the time it was a self-sufficing country; food was practically the only need of its population, and food the irrigated Nile Valley and delta produced plenteously. Geographers now write much of the increasing separation of the home and work space on the one hand and the sustenance space on the other. As a matter of fact they are still quite close together, so far as the bulk of the world's population is concerned.

COUNTRIES DEPENDENT ON IMPORTED FOOD

Here it may be objected that, while it is true that a very high percentage of the peoples of the world are still dependent for existence almost exclusively on their home production of food (80 per cent of the working population of India is engaged in agricultural pursuits), it is also true that under modern conditions other prosperous and large groups get a large proportion of their food from abroad. Thus Great Britain before the world war imported 47 per cent of the food requirements of its 45,000,000 inhabitants, and Belgium 43 per cent of the needs of its 7,500,000. These are, however, exceptional instances; the other important food-importing

countries, Italy, Germany, France, and Austria-Hungary, did not attain nearly so high percentages of food imports to total food needs.

But Great Britain and Belgium did succeed in supporting their populations largely on imported foods, and this fact immediately leads to the conclusion that such practice may be much extended. It is argued that the expansion of all Western Europe in population and prosperity has been due to the utilization of the vast new lands of North America and elsewhere for the production of a flood of new food. But this ignores the true inwardness of the situation. It was not the knowledge of these virgin lands nor even their occupation that made cheap imported foods possible. Rather it was the fact that between the years 1870 and 1890 the transportation of bulky products was revolutionized. Had it not been for that development the production of surplus foods in outlying regions would not have occurred, as indeed it was not large before 1870, though a large part of these lands were then available. Between 1870 and 1890 railroads multiplied, steamship capacity was doubled and quadrupled, speed of service was increased, charges much decreased. In 1869 it cost approximately 37 cents to transport a bushel of wheat from Chicago to Liverpool, in 1905 only about 10 cents.³ Even so, the change to dependence on imported wheat was in Great Britain brought about in part fortuitously, for between 1853 and 1873 agriculture was prosperous in the English lands, only 10 per cent of the people being fed with imported wheat, while 1876 and 1877 were bad years in English crop production, and this fact, coupled with the expansion of transportation facilities up to the present, is responsible for 90 per cent of Great Britain's wheat consumption being supplied after 1906 from other lands.

TRANSPORTATION COSTS AS A HINDRANCE TO THE EXTENSION OF FOOD-PRODUCING AREAS

The same factor of transportation cost is now as much effective as ever. As Dr. Smith himself points out,⁴ London is the price-setting market for wheat, and eastern Idaho is a traffic divide for wheat moving east or west to that market. In eastern Idaho the producer, accordingly, receives of all growers the lowest price for his wheat (if an export surplus is grown in his district⁵)—in a given year 30 cents less than the price at Chicago. In Persia a distance of 300 miles makes the difference between \$1.00 and \$10.00 as the price of 650 pounds of wheat, and the excess supply of the rich oasis rots because the transportation cost over this 300 miles is even greater than the price difference.

Apply this principle next, then, to the vast marginal lands in Canada

³ F. A. Ogg: *Economic Development of Modern Europe*, New York, 1917, pp. 162-165.

⁴ J. Russell Smith: *op. cit.*, pp. 33-34, and L. B. Zapoleon: *Geography of Wheat Prices: Summary of Conditions Affecting Farm Prices of Wheat in Different Parts of the United States*, U. S. Dept. of Agric. Bull. No. 594, Washington, D. C., 1918.

⁵ C. S. Scofield: *The Geographical Factor in Agricultural Industries*, *Geogr. Rev.*, Vol. 1, 1916, pp. 48-49.

and Siberia that are adapted to wheat production. Every additional mile that wheat growing is extended beyond the present limits (with existing *routes*, not *lines* of transportation) means that the London price must be a fraction higher if the grower in those remote regions is to find his occupation profitable with equality of sacrifice. Moreover, any rise in price means that in the nearer wheat lands some intensification of agriculture will pay, that is more human effort can be expended in cultivation of the crop with expectation of a higher yield. The law of diminishing returns of course puts a limitation on the possibilities of profitable intensifying, but considerable increases in yield can be attained without too much expenditure of effort in the older lands; hence this fact, together with the increased cost of transportation, makes the occupation of the outlying lands a slow process and one that only comes about as an accompaniment of distinctly higher prices, that is an increasing handicap on the import of food by peoples whose production is deficient.

THE DILEMMA OF INCREASED SUPPLY OR LOWER STANDARDS OF LIVING

Dr. Smith recognizes this situation, too, but argues (pp. 413 and 412-413): "We may have to choose some day between more and more mechanical goods and more food." "The most conspicuous feature of the conditions of living in America, and to a large extent also in England, France, and Germany during the last twenty-five years, has been the rising standard of living— five million automobiles [owned] by the people of the United States , millions of phonographs in the homes alike of workmen and millionaires , without any appreciable reduction in the sale of any other kind of goods, save carriages." Again (p. 239): "No discussion of unused meat resources should cause us for a moment to forget the fact that there is no prospect of permanent relief in sight. That small minority in the Western World who have so nearly monopolized the world's meat will have to reduce their consumption."

In other words, increase in the world's food supply is indefinitely extensible at the cost of reduced standard of living, sacrifice of comfort—until perchance all the world's population sinks to the level of India's hordes. Pleasant prospect. On the contrary, increase in the world's food supply means nothing unless we can keep all we have of mechanical appliances and increase their number, automobiles, phonographs, bathtubs, "movies," clothes, etc. It is pointed out that Canada has for years offered 160 acres of rich level prairie land, adapted to wheat raising, for the taking; but also that this land is twenty to thirty miles back from the railroad, is bleak, windy, and often quite treeless. It might be added that it is fearfully cold in winter, that fuel is difficult to get, that house-construction material is very expensive, that there is no social life. How eager is the reader to quit his present work to go out to this rich prairie and add to the world's food supply? Similarly if we need to give up meat and wheat

and resort to the equally nutritious but less palatable rye, barley, maize, millet, soy beans, acorns, and coconut butter, our joy of life declines so much. It may be that we are capricious and conservative in our choice of foods, but the fact remains that the Russian peasant prefers wheat bread to rye bread when he can afford it; and the circumstance that Kaiser Wilhelm "used occasionally to trade the white bread of the palace kitchens for the black rye bread of a peasant boy," as Dr. Smith tells us (p. 74), may have been one of the Kaiser's few endearing acts, but it is also another example of his preferences that we do not care to adopt as a matter of necessity. (Incidentally, it is extremely curious how this idea, that the whims of royalty are an adducible argument in favor of the acceptance of any given notion, persists, even when such a personage as Wilhelm must be cited. One could understand a professor's pointing out that another learned man preferred rye bread to wheat bread, but this other idea is evidently a mental survival from the Middle Ages.)

There are, of course, commodities that the world can well dispense with and thus have more energies available for the production of food—alcoholic liquors, for example. It is a rather curious fact that, in the voluminous newspaper and magazine discussions on the subject of extravagant spending and prohibition in the United States, so little appears about the effect of diverting the millions formerly spent for drink to the purchase of other commodities, not to mention the conservation of all the grains and other agricultural products that were needed to produce such beverages. In this there has been a real expansion of the food supply, coincident with increased purchasing power for other comforts.

"HUMAN NATURE" AS AN OBSTACLE TO EXTENDING FOOD-PRODUCING AREAS

A mere searching out of the geographic possibilities of extension of food resources that does not take into true account varied human traits is apt to lead to very unsafe deductions. Argentina has fine wheat lands, so located with reference to transportation lines and the London market that their product could be very profitably sold at prices prevailing before the war. But vast tracts of this land are in the possession of a few owners, who derive incomes entirely adequate to their luxurious tastes by using the lands for sheep pasturage only; and this disposition of their acres leaves the owners much more free to pursue lives of pleasure than when they are bound down by the exacting superintendence necessary to make a success of wheat growing. Again, quoting Dr. Smith once more (p. 524): "It is generally expected that thousands of soldiers, for years freed from the restrictions of city life, will insist upon the freedom of out-of-doors." Quite the contrary, however, proves to be the case, as might indeed have been surmised if the prophets themselves had had the experience with the out-of-doors which the soldiers had. A little out-of-doors, a camping holiday, is a lark to the city dweller, but the doing without all the customary

comforts and conveniences, warm baths, clean clothes, theaters, stores, and books, for indefinite periods of time arouses rather, in the urban born and bred, a fierce longing to be once more and for always provided with city surroundings. And if the soldier did have ideas of developing government land, it is more than likely that his city-bred girl would look askance at the idea of becoming a pioneer's wife. Hence the notion that the Mississippi River swamps will be reclaimed and made food-producing by the returned soldier must be dismissed as an idle dream. Even where conditions for going on the land are most favorable, as on the government irrigation projects, it is said to be difficult to get settlers, because these lands do not give any promise of a speculative profit—they offer a livelihood but not the opportunity to sell out shortly at a large increase to some other fellow. Something of the same nature will prevent the wider utilization of tree crops. While the return from tree crops may be handsome, after a number of years, the wait often occupies so large a part of a man's lifetime that few have the faith and patience, to say nothing of the necessary capital, to plant such a crop. And success is by no means assured: a grove of chestnut trees may succumb to the blight, of oranges to a frost, of coconuts to a hurricane or to bud rot.

POPULATION INCREASE

What has already been suggested will suffice to indicate that the world's food supply cannot be expanded indefinitely as easily as one slips on an old shoe. On the other hand the numbers of people who need to be fed do seem to expand with something like that kind of facility. Since 1800 the world's population has increased from 640,000,000 to 1,693,000,000, or nearly tripled in a century and a fifth. Moreover, the greater part of this expansion has taken place in those countries which have been affected by modern Western civilization.⁶ Europe, which in 1741 had an estimated population of 127,000,000, in 1914 was occupied by 452,000,000. Under British rule, accompanied by introduction of the devices and discoveries of the Western world, the population of India increased in 39 years from 186,000,000 in 1872 to 244,000,000 in 1911, or by some 58,000,000 souls. In Japan the population increased from, in round numbers, 33,000,000 in 1871 to 54,000,000 in 1914. Of two periods, "each of 43 years, one just before and the other just after the opening of Japan to influences from Europe," "in the later period population increased three times as fast as in the earlier."⁷ In North America, in Australia, New Zealand, South Africa, Egypt, Argentina, Java, and the Philippine Islands, the same sort of tremendous expansion of population has taken place, a phenomenon probably without precedent in history, the possible exception being ancient Egypt.

⁶ W. F. Willcox: *The Expansion of Europe in Population*, *Amer. Econ. Rev.*, Vol. 5, 1915, pp. 737-752.

⁷ Willcox, *op. cit.*, p. 750.

On the other hand, according to the best evidence available, there has been but little if any increase in the population of China between 1850 and the present time. In the heart of Africa it is estimated that there has been a reduction in population in 32 years of 70,000,000 people—from 206,000,000 in 1882, to 136,000,000 in 1914. Meanwhile, however, the comparatively few thousands of negroes carried to the Americas as slaves had increased so that they numbered 13,000,000 in 1915.

THE CLOSE RELATION OF POPULATION GROWTH TO FOOD SUPPLY

What is the significance of these facts in regard to population growth or decrease with reference to the food supply? Essentially it is a verification of the Malthusian doctrine that populations tend to increase as fast as the food supply. This can be otherwise put by saying that the increase in numbers that normally accompanies the availability of more food prevents any improvement in the standard of living. Thus the British and the Dutch, by introducing new methods for increasing the efficiency of agricultural labor and extending its scope in India, Egypt, and Java, without at the same time changing the cultural status of the coolies and the *fellahin*, have not, so far as these natives are concerned, materially improved the food situation. Accompanying the increase in income from their lands has come such an expansion of population that they are as near famine and starvation as ever. In Japan, similarly, no appreciable improvement in the standard of living of the mass of the people appears to have accompanied the increase in population, though the productivity of the country as a whole has been increased by the absorption of the energies of these greater numbers in the development of machine manufactures and shipping. It is said that before the world war Japan was reclaiming each year an area sufficient to feed 200,000 people and that new lands, available to be reclaimed, will provide for 30,000,000 more at the present standard of living; but this prospect loses all its impressiveness when it is offset by the fact that in the last 43 years the population of Japan has increased at the rate of about 500,000 people per year. It is true that a comparatively few Japanese, Indians, Dutch, and British have become enriched in the process of expansion and improvement of methods; but no larger surplus of food has resulted, nor has there been any more food per coolie available in those countries than there was before.

EFFECT OF THE WAR

It does not suffice to assert that population does not increase in geometrical ratio over large areas for long periods of time and that there is therefore no danger of a food shortage, for very evidently the figures indicate that population has been increasing with extraordinary rapidity for considerable periods and over all the areas in which we are most interested. The effect of the war on food supply furnishes a confirmation of

the conclusions that such facts suggest. Sources of food normally available to the Western world were then shut off, because of lack of shipping and the war blockade and because millions of men were diverted from crop production to war work. In effect both these changes were the equivalent of a great increase in population. Was there immediately available an enlarged food supply to meet the new need? War rationing and the present plight of much of Europe and the rate of exchange even for English pounds is the sufficient answer. Despite the stimulus of higher prices and the adoption of many expedients that made possible an actual net gain in food supplies and a lower standard of living even in America for the war years, there is a shortage. Recovery seems possible only by condemning the European peoples, particularly, to a still lower standard of living than prevailed before the war. The same trend is indicated in America by the reiterated editorials against extravagance which are to be interpreted simply as admonitions to reduce the standard of living and expend more energies (increase production) that food supplies and capital accumulation for the further extension of food-producing areas (by increasing transportation facilities, for example) may be made available. More food, yes, at the cost of the expenditure of a greater proportion of the total sum of human energy to meet the needs of an increasing population.

REASONS FOR NON-INCREASE OF POPULATION OF CHINA AND INTERIOR AFRICA

Why has the population of China remained stationary and that of interior Africa actually decreased during practically the same period in which these tremendous increases in population were occurring elsewhere? Not because births were any less numerous in China or Africa, but because the deaths equaled or exceeded the number born. The causes of those deaths are illuminating. In China famine, flood, pestilence, and civil war devoured the natural increase of normal years. In 1849 some 14,000,000 Chinese perished of hunger. And it may be concluded that if pestilence, disaster, and civil war (itself probably the result of hunger) did not clear off the surplus population so often there would be more famines to bring about the same results. In Central Africa the same conditions apply, plus the effects of the overland slave trade. Here Western civilization secures the products it wishes from the country without introducing any devices to increase food supply, and as this means that the energies of a certain proportion of the natives (while they continue to live and require food) are diverted to other tasks, the efforts of the rest, using the old methods, will not suffice, and some must perish.

GREATER EFFICIENCY IN PRODUCTION THE CHIEF HOPE FOR THE FUTURE

The prospect so far presented seems altogether dismal and in entire contrast with Dr. Smith's optimistic anticipations. But the future is not altogether dark. The possibilities that promise an increase in food supplies,

without a corresponding increase in human effort, have been ignored (except by inference) in the preceding paragraphs and must now be taken into account.

The fact is that a popular misconception of what are the really significant possibilities for obtaining an enlarged food supply has prevented a rational understanding of the subject. Writers, generally, have so much emphasized the future importance of the geographically unused land areas of the world, particularly the tropics, that the public has been fascinated by this lure to such an extent as to ignore other factors that will more certainly fulfill expectations. The chief hope for the future lies in the promise of greater efficiency in production by the human race itself. Every device and every discovery that leads to enlarged food production without also entailing more human labor may be counted as contributing to a net gain in the world's well-being, provided that such increase in food is not absorbed by an increase in population of equal consuming capacity. Even if the total quantity of food now produced, relative to population numbers, is not increased, if only a proportionately lesser number of workers are able to produce as much food as is now available per person, there will be a gain, for the toilers who are thus released can devote their efforts to the production of other commodities for our comfort. Contrariwise, if some new invention in mechanical processing of materials makes possible the same output with a less number of operatives, then we have so many more individuals available for the intensification of agriculture—similarly a net gain. It is said that an increased wage paid an Indian coolie ordinarily results merely in his being willing to work only five days in the week where before he worked six, even though his hunger is not fully appeased. The sacrifice of toil is to him greater than the internal pangs due to insufficient nourishment. It has been found that this aversion to toil is largely due to the effects of the hookworm disease; hence eradication of that ailment in India, as in the American South, will make the coolie, like the negro, more productive without subjecting him to greater physical wear than he now endures.

It has been suggested in an earlier paragraph that the extension of wheat growing farther into northwestern Canada under existing conditions would afford no relief because such an extension could only be made possible by a rise in price. Additional railway lines would not help *unless* they shortened the distance over which transportation was necessary. Hence, also, when the railway line from these areas to Hudson Bay is completed, an immediate great gain will have been achieved, for then this region will have a shorter outlet to the seaboard, with the attendant cheap transportation of ocean carriage, and its wheat crop can enter the London market at a profit at the present price level. Again, if some mineral product of high value and small bulk should be found in the Canadian region, and farmers adjacent could grow the food necessary to support the mining population,

the problem of utilization of these areas would be solved. This is the function of vegetable and meat production (cattle, reindeer, yak) in northern and interior Alaska in connection with gold mining there. If any person is dazzled, however, by the apparent possibilities of unlimited extension of agriculture into distant undeveloped lands he should read, for an appreciation of the true economic situation, Scofield's account⁸ of the problems of the farmer in a remote irrigation area.

VALUE OF MACHINE PROCESSES

Machine seeding and harvesting and the roller process in flour making, combined with the development of railroad and ocean navigation, provided Europe with bread made from hard spring wheat. The recent application of machinery to rice growing in Texas and Louisiana promises to bring about a similar reduction in the cost of growing that grain. Even now, with high-priced labor, it is possible to produce rice there at a lower cost than can the cheap coolie by his garden cultivation. In actuality the agriculture of China, particularly, is wasteful and inefficient in many respects, and we may see the day when machines will produce more rice with less labor in China than its struggling millions have ever made the earth bring forth. Our old farms and the old crops are having their labor costs reduced by the farm tractor; its use will make profitable the development of lands climatically uncertain, as one or two crop failures in five will not spell the disaster that would ensue with horse cultivation; similarly the tractor will permit the fallowing of land for alternate year cropping. The centrifugal separator and mechanical milkers have in like manner reduced dairying costs.

SCIENTIFIC AGRICULTURE

Varieties of wheat requiring a shorter season to mature or made drought-resisting by plant breeding, of potatoes and sugar beets bred to give higher yields, selection of peaches with green bark to prevent too early budding and frost injury, larger yields from the same fields by introduction of alfalfa hay, the soy bean, and the peanut—all make for true gains in the total food supply. Fertilizers from new sources, nitrogen from the air, and coke-oven by-products, phosphorus from the blast-furnace refuse will also enable the same acres and the same labor to produce additional food.

More scientific practice of agriculture, generally, can do much to enlarge the food supply. By terrace plowing, water pockets, and use of explosives moisture may be conserved and soil erosion prevented. In Hawaii the rows of sugar cane are covered with paper which the young shoots of the cane can penetrate but which prevents the growth of weeds. Ensilage permits the use of all the corn plant; animal industry carried on in connection with ensilage feeding enriches the farm with manure; crop rotation of the proper kind keeps farm labor busy at all seasons; the hog can be used

⁸ Scofield, *op. cit.*

to harvest peanuts, goats to crop steep hillsides, sheep can be made profitable by eliminating the useless dog. In Brazil the Indian zebu⁹ has been introduced because it has been found that such hybrids are immune to tropical cattle diseases (particularly Texas fever) and give fine meat; in Germany the same hybrid is found to be resistant to tuberculosis. Cattle raising in all the warm parts of the world where pasturage is abundant the year round is thus made possible. In Africa a cross with the zebra is providing a similarly immune work animal. As it has been established that salmon return to the stream in which they were born it will be profitable for privately owned canneries to conduct hatcheries and assure themselves of a perennial run of fish.

Tree crops also promise much. Spraying assures saving the yield of many fruit orchards; it has been found that orchards on slopes escape frost damage. With proper mulching it may be possible to grow olives on the American Great Plains. Indigo chemically produced has freed lands for food crops, as may also synthetic rubber. The cotton seed and the palm kernel are no longer wasted, the coconut by chemical treatment yields a substitute for butter fat, maize now supplies us with corn oil and corn syrup.

BETTER FOOD CONSERVATION AND DISTRIBUTION

Modern dehydration, without destroying flavor, enables us to conserve the seasonal oversupply of perishable vegetables without recourse to expensive canning, particularly the difficultly stored sweet potato and the watery tomato. If, in addition, we can bring ourselves to accept so much of socialistic doctrine as to provide for public purchase of conservable crop surpluses in any one region and store them in government-owned warehouses, we can at once insure the grower and stabilize prices. Dried milk is already on the market. Improvement in refrigeration may make available such tropical fruits as the dasheen, the plantain, the avocado, and the mango, as well as the banana.

Better transportation and distribution will permit wider use of materials that now often go to waste. A barge load of apples from the northern New York region tied up at the East Side in New York City would find a ready sale. Motor trucks permit outlying farmers to grow green vegetables for city consumption. The dispersal of industry to suburban districts will make chicken raising and bee keeping possible for the workman. An acquaintance got 600 pounds of honey from hives in his back lot during the season of the sugar shortage.

Most of these items Dr. Smith suggests, as well as others of similar nature that his wider knowledge permits and which have been missed here. Every one of them opens, or has opened, the possibility of a larger food supply at no increase in human effort. Taken together they afford promise

⁹ See *Bull. Pan Amer. Union*, Vol. 40, 1915, pp. 674-679, quoting B. H. Hunnicut and José María Dos Ries from *Journ. of Heredity*, May, 1915.

of enough to eat in the immediate future. But their general nature will sufficiently indicate that time is needed to bring them into play. We are not threatened by any avalanche of new food in the next few years. Will population growth in the meanwhile outstrip inventive genius for providing food increases? Perhaps the best preventive for that will be a world insistence on a higher standard of living in all countries, as the surest method of checking the poverty swarming that now obtains in some areas.

CERTAIN RECENT DISCUSSIONS OF THE FOOD PROBLEM

The argument thus far has been general rather than specific. Therefore it seems due the reader who has been sufficiently interested in the subject to pursue it to this point that recent detailed discussions of various phases of the general problem be brought to his attention, as indicative of the sources from which information and opinion on the several factors involved may be gained.

The "Geography of the World's Agriculture," recently reviewed in these pages,¹⁰ contains, in addition to its many valuable maps and accompanying discussions of the distribution and production of the world's food crops, on pages 148-149 a bibliography of the more important statistical sources on agricultural production in all parts of the world.

INTERNATIONAL APPORTIONMENT SUGGESTED BY WAR CONDITIONS

Reference has already been made to an article by G. B. Roorbach in the *Annals of the American Academy of Political and Social Science*. All the November, 1917, number of this publication is devoted to the general subject of "The World's Food." The contents comprise about three dozen different articles, each by a different author, grouped under four heads: "The World's Food," "Food Utilization and Conservation," "Production and Marketing Plans for Next Year," "Price Control." The article by Roorbach bears most directly on the general topic of the present paper and contains much interesting matter in the way of comparative statements of food production and consumption in the different countries. Roorbach's main contention is that in any one year the margin of food production over food consumption is very narrow. Written at the crisis of the war, it is only natural that the chief emphasis of all the papers should be on the immediate problem of war needs. Nevertheless, B. S. Butler, in a contribution on "International Rationing" predicts (p. 40) that the after-the-war period will see the adoption of some scheme by which all raw materials, including food, will be internationally apportioned. Thus Italy, for example, will engage to sell the United States a certain bulk of olive oil only on the basis of receiving from us a fair exchange value in raw materials of our production which Italy lacks. The present tendency,

¹⁰ V. C. Finch and O. E. Baker: *Geography of the World's Agriculture*, Office of Farm Management, U. S. Dept. of Agric., Washington, D. C., 1917. Reviewed in the *Geogr. Rev.*, January, 1920, pp. 74-76.

because of the collapse of international exchange, to international barter of commodities, is, in this connection, suggestive.

Representatives of the neutral nationalities each present the plight of their country in respect of food, and, while we may, without malice, assume that they made their several needs appear as urgent as possible, there was probably no downright overstatement. Fridtjof Nansen points out (p. 44) that, despite the fact that in many years emigration from Norway was greater than one half the increase in population by birth and in some years equal to the total of such increase, that country's increase in population during the last century had nevertheless been the greatest in all Europe and was in the ratio of 100 to 254; also that agriculture was still the main resource of Norway and that, while its practice had been much intensified, the returns had not kept pace with population growth. Hence Norway needed now to import 58 per cent of her grain requirements, $33\frac{1}{3}$ per cent of her fats, and all her sugar. A. R. Nordvall (pp. 57-58) stated that, while, between 1820 and 1830, 82 per cent of all the Swedes were agricultural workers and in 1910 only 48 per cent, Sweden was nevertheless producing greater crops now; but that in spite of this, whereas formerly there was an export surplus, now about one-fourth of their food requirement was imported.

For the Allies the food situation of Japan (pp. 81-82) was indicated by Viscount K. Ishii as not serious, but only because of Japanese frugality as compared with the "magnificent luxury" of America, as Japanese food requirements were limited to the barest necessities of life and the nation's diet consisted mainly of vegetables, rice, roots, and barley. François Monod reported for France (p. 84) that French wheat production before the war barely equaled home consumption, Arthur Pollen for Great Britain (p. 91) that by weight one-fourth of all British food was imported.

ESSENTIAL ELEMENTS IN FOOD

In the section entitled "Food Utilization and Conservation" is a very suggestive article by E. V. McCollum entitled "Some Essentials to a Safe Diet" (pp. 95-102), emphasizing the significance of the two unknowns in food substances, generally referred to as vitamins. The author points out that while cereals are the cheapest energy foods, all seeds are deficient in one of these two food essentials. This, the "A" vitamin, is, however, plentiful in milk, in eggs, and in plant leaves. The "B" vitamin is absent from polished rice, from both vegetable and animal fats, from sugars and starches. Lack of the first vitamin produces eye trouble in children; deficiency in the second, beri-beri disease, the characteristic of which is general paralysis.

Here is introduced a factor of the food problem that has only been touched upon in the preceding paragraphs. The obstinate refusal of the North European peasantry to adopt our high-yield corn as a chief food

staple has been much commented on. But it appears that there is a good reason behind this instinctive aversion. The maize kernel is found, by actual experimentation with human beings, deficient in three ways as human food. Its proteids are not of satisfactory character, it lacks a sufficient amount of "A" vitamins, and it is too poor in inorganic salts. While this indictment in a general way applies to all cereals, corn alone, in particular, will not support physiological well-being in a growing animal. Moreover, it appears that their customary unvaried corn bread, salt pork, molasses diet is responsible for the fact that thousands of the working people of the American South at the end of winter suffer from pellagra, as do also the Italians, who subsist largely on polenta. If milk is used, meat can be dispensed with, hence vegetarianism is entirely feasible. But the cost of milk must go up and up as far as is necessary to preserve the dairy industry, and an adequate supply of green vegetables must be made available to the city dweller. Green vegetables because of spoilage are hazardous stock for the retailer; hence the exorbitant prices usually charged. The alternative is a resort to a bread made up of cereal with an admixture of alfalfa-leaf flour. To be sure, such a bread would be slightly green in tint and astringent in taste, but small matter that to the food enthusiasts who urge blithely that if we will only overcome our silly prejudices there is food in plenty.

THE PROBLEM OF MARKETING

A. B. Ross, under the title "The Point of Origin Plan for Marketing" (pp. 206-210), proposes a solution for this problem of green foods by the establishment of standardizing plants located at the strategic geographical points between a given producing region and its city market. He suggests that all raw produce from the farm shall pass through such plants and, under direction of an expert, be graded, prepared for the retail market, and placed in cold storage or canned whenever there is an oversupply of perishables at a particular time. Retailers' and consumers' co-operatives generally could depend on such a regional institution for all requirements of the local market, and this would do away with the erratic and expensive transshipment now characteristic of the distribution of many perishable foods.

Herbert Hoover¹¹ likewise maintains that agricultural industry must be made to pay adequate returns to the farmer and concurs in the finding that the excessively high cost of foods to city customers results from faulty transportation and the altogether disproportionate spread in price between the wholesaler and consumer. Like Ross, he finds this to be due in part to the wide distances, often, between the producing areas and their markets, which could usually be remedied; and the fact that each of the

¹¹ H. C. Hoover: Some Notes on Agricultural Readjustment and the High Cost of Living, *Saturday Evening Post*, Vol. 192, 1920, April 10, pp. 3-4, 45, 46, 49, 50.

intermediaries concerned in this faulty distribution system, wholesaler, transportation agent, commission man, cold-storage warehouser, food manufacturer, retailer, must make a separate profit on his investment; and, as each one of them conducts his business on a percentage basis, every increase in the original payment to the farmer is many times enlarged before the commodity gets to the consumer.

RELEASE OF LAND BY NATIONAL PROHIBITION

Reverting to the *Annals* articles there is one more paper of interest, that of A. C. Bigelow (pp. 191-197), "The Sheep Industry of the United States," in which it is stated that between 1900 and 1910 the acreage of land under cultivation in the United States showed a per capita decrease of 10 per cent and that production, by commodities, of butter, oats, wheat, and corn, decreased 10, 11, 15, and 21 per cent respectively per capita. On the other hand R. E. Smith¹² estimates that 3,600,000 acres devoted to corn, barley, and rye for liquor production have been released for food growing by national prohibition and that, altogether, prohibition has directly and indirectly freed some 5,000,000 acres, enough to feed 4,000,000 people. Because of high prices during the war years, he further estimates that some 25,000,000 to 35,000,000 more acres of American land, formerly waste and pasture, were brought under cultivation.

CHECKING OVERPOPULATION

It is quite distressing to proceed indefinitely in a pessimistic strain on this subject, hence the slight relief suggested by this recovery of land for food through prohibition is pleasing. And the situation is not altogether hopeless. But all the remedies proposed approach the problem from the wrong side. While it is altogether laudable to urge all possible means for increasing the food supply and procuring its better distribution, it ought to be made a first object of the nations of the world to "succeed with what they have" instead of desiring to expand indefinitely in numbers regardless of the present world provision for subsistence. In other words it should be much easier to curb overpopulation than to provide new avalanches of food.

Readers of this *Review* will therefore find of equal interest an article by J. O. P. Bland¹³ in which five books and papers of great geographic significance are reviewed, inasmuch as the contributions that Bland ana-

¹² R. E. Smith: *Thirty Million More Acres*, *Independent*, Vol. 97, 1919, pp. 292-293.

¹³ J. O. P. Bland: *Population and Food Supply*, *Edinburgh Rev.*, Vol. 227, 1918, pp. 232-252. The five publications reviewed are:

James Marchant: *Birth-Rate and Empire*, London, 1917.

The Declining Birth-Rate: Report of the National Birth-Rate Commission [of Great Britain], London, 1916.

C. K. Millard: *Population and Birth Control: An Address*. Leicester, 1917.

Adelyne More: *Fecundity Versus Civilisation*. London, 1917.

William Bateson: *Biological Fact and the Structure of Society* (Herbert Spencer Lecture, 1912). Oxford, 1912.

lyzes all emphasize the effect of the factor of population growth. In what follows the figures for birth and death rates and other vital statistics are, unless otherwise indicated, taken from this article.

Bland points out that the various panaceas that have been proposed for the amelioration of human woes recognize that the first essentials in such a program are the reduction of poverty and the elevation of standards of living among manual workers, but that, contrariwise, the proposers of such panaceas usually refuse to recognize that the fundamental cause of economic pressure is overpopulation. Any proposal for the limitation of numbers in a given national group seems to be instinctively resented and to provoke a feeling akin to race hatred. Hence, Bland says, positive checks—war, pestilence, famine—must operate. The fecundity of the human race has become adapted to these positive checks. In the Middle Ages the European birth rate was 45 per thousand, and the death rate the same; during the last century the birth rate has not been greatly reduced, but the death rate is only 14 per thousand. Hence the enormous increases in population of modern years. M. Hardy, a French scientist, is quoted to the effect that an equal distribution of the total proteids annually available in foods would give each individual only two-thirds the amount necessary for physical efficiency and that this shortage would exist even if the underfed masses of India and China were eliminated from the calculation.

POPULATIONS CANNOT INCREASE INDEFINITELY

Opposed to the obvious remedy for such conditions a number of factors operate. Because the exploitation of a virgin America, the development of transportation facilities, and industrialized mechanics permitted large increases in the population of the temperate zones during the last century with some actual increase in comfort for all, it is popularly conceived that this increase in numbers can go on indefinitely without bringing into operation the law of diminishing returns. Here it is overlooked, first of all, that the former food reservoirs are rapidly developing their own industrial civilization and increasing their populations correspondingly, so that shortly they will not produce an export surplus of food. The United States has only recently arrived at this very point; New Zealand, Australia, Chile, and Argentina will follow.

THE RACE PRESERVATION INSTINCT

A second difficulty is the instinct of race preservation and national expansion, already referred to, which has for its practical basis the militarist need for man power and the capitalistic requirement of cheap labor. In view of the war extremities then prevailing one can forgive the statement of Sir Bernard Mallet in his presidential address before the Royal Statistical Society on November 20, 1917,¹⁴ to the effect that many people see

¹⁴ Sir Bernard Mallet: *Vital Statistics As Affected by the War*, *Journ. Royal Statistical Soc.*, Vol. 81, 1918, pp. 1-36. London.

in the declining birth rate of Europe a cause for congratulation in view of the foreseen shortage in the world's food supplies, but he, even if this shortage is actually impending, which he doubts, would be unable to look with indifference on the phenomenon of the declining birth rate. "His attitude towards the general problem of population was decided by the instinct of race preservation." He might have taken heart if he had considered the record of the "degenerate" French during the war and the facts of population in New Zealand and Holland as set forth below.

RELIGIOUS TEACHINGS

The third and last difficulty in bringing about any reduction in national increase is the influence of religious teaching. "Be fruitful and multiply," "replenish the earth," "the Lord will provide" are the precepts of the Old Testament Jewish, the Confucian, and the Indian religions alike. The Chinese and Japanese ideas of ancestor worship are akin to these religious precepts in their effects on population increase. Such religious teachings may have been well enough adapted to the times when they were first promulgated, but they scarcely fit now. There will no doubt be readers of these lines whose religious susceptibilities will be offended by such attitude, but, before they take up the cudgels with the humble author or Mr. Bland or the authorities he quotes, let them consider first the apparently well-authenticated fact that the clergy of the Church of England, who continue to urge an unrestricted birth rate and who forty years ago practiced what they preached (for the birth rate of their group was above the national average), now have a birth rate near the bottom of the list, close to that of the medical profession and the teachers, who are lowest, and only one-half that of the coal miners and the agricultural laborers, who head the list!

BETTER PEOPLE NEEDED RATHER THAN MORE

The other and much more rational view is that stated by Professor Bateson, as follows: "To spread a layer of human protoplasm of the greatest possible thickness over the earth—the implied ambition of many publicists—in the light of natural knowledge is seen to be reckless folly. . . . We need not more of the fit but fewer of the unfit."

Infant mortality increases regularly in proportion to the size of the family. In China 75 to 85 per cent of all babies born die in infancy; the birth rate is 50 per thousand. If the death rate of China were reduced to the European level and there were no counteracting forces there would be 4,000,000,000 Chinese in 100 years. In Bombay, India, the infant mortality was 322 per thousand in 1911, in the same year in London it was 91 per thousand. In the following statement the first figure in each class gives the births, the second the deaths, per 1,000 married males under 55 years in England. Upper and middle class, 119:76.4; skilled workmen, 153:112.7; unskilled workmen, 213:152.5. The effect of large families is only to fill graveyards with human waste.

But, it will be urged, reduction in number of births spells race suicide, particularly since, altogether aside from chauvinistic national ideals, the reduction is greatest just in those classes that it is desirable should be perpetuated. Such is not, however, the case. In 1860 the birth rate in New Zealand was high, over 40 per thousand; in 1911 it had declined to 26 per thousand. But at the same time the death rate had been reduced to 9.5 per thousand, the lowest on record, and the natural increase due to the excess of births over deaths sufficed to double the New Zealand population in 44 years. Nevertheless the Bishop of London in 1913, having this low New Zealand birth rate brought to his attention, was constrained to utter grave warning in view of the "glorious fertility" of China and Japan. Of even greater significance to geographers is the record of Holland. In that country birth-rate restriction was made a matter of national policy on humanitarian and eugenic grounds. Between 1881 and 1910 the birth rate fell to 28 per thousand, the death rate to 12.3 per thousand, the lowest in Europe. In the last fifty years the average stature of the Dutch people has increased by 4 inches, and the physical and social status of the population has much improved. The Dutch themselves attribute this betterment of the national stock to education of the poorest and the physically unfit in regard to the evils of families unrestricted in size. Here, again, it will be hard to find any other way to "beat the Dutch."

NO PROSPECT OF DECREASE OF YELLOW AND BLACK RACES

There is, however, little doubt but that, despite the various difficulties, preventive checks on the birth rate will come to be generally applied in the near future in all temperate lands and among all European peoples. The real danger zone is in the tropical and subtropical lands inhabited and occupied by the yellow and black races. These areas are the potentially great food reservoirs of the future and the naturally complementary trade areas for the temperate lands. In exchange for their raw products we can furnish their peoples with our industrial products. But it seems to be quite well demonstrated¹⁵ that the white race cannot work, flourish, and procreate in such latitudes. Hence development of the tropics must depend on the labor of tropical native peoples.

But these peoples, blacks, Chinese, East Indians, when protected by European supervision from the positive checks of war, pestilence, and famine, tend immediately to fill up their countries to the absolute level of subsistence. In India, owing to irrigation extension and public sanitation introduced by the British, the population increased from an already crowded 287,000,000 in 1891 to 315,000,000 in 1911 without in the least improving the economic conditions of the coolie. Governor Yager¹⁶ has

¹⁵ See Griffith Taylor: *The Settlement of Tropical Australia*, *Geogr. Rev.*, Vol. 8, 1919, pp. 84-115, for a very careful and authoritative statement on this point; also the writings of Ellsworth Huntington.

¹⁶ Arthur Yager: *Overcrowded Porto Rico*, *Geogr. Rev.*, Vol. 1, 1916, pp. 211-212.

made very clear the similar effect in an American tropical possession, and a recent publication by the Department of Commerce¹⁷ supplies like facts with reference to Barbados and Jamaica. In fact, of all the West Indies, only in Cuba, where a white South European population predominates, are the standards of living reasonably high according to our measure.

The only alternatives available to combat these conditions, to prevent the tropical peoples from so completely occupying their lands (once positive checks to population growth are removed) that only a meager existence will be afforded the indigenous population and no room be available for plantation culture and export production in exchange for temperate-land manufactures, and, at the same time, to secure the toil of the natives, are: either forced labor under European supervision—virtual slavery, against which all enlightened thought rebels—or the raising of the standard of living among the black and yellow races.

THE DIFFICULT PROBLEM OF THE TROPICS

But this last and only solution is not an easy one to apply. The tropics are and must always be the land of tomorrow. What can be done one day can just as easily be done the next, for it will be just the same as that just passed; no necessity for seasonal provision for the future or old age is imposed by climate or the conditions of natural produce. Industrial and agricultural education, a living wage, and extraordinary incentives to purchase and use the comforts and recreations afforded by temperate-land devices, improvement of agriculture by better practices and introduction of labor-saving machinery, substitution of diversified production for the one-crop method that is now typical of each of the different districts, will all help toward such an end. But great problems remain to be solved. Some of the tropical areas are overpopulated, others almost altogether lack inhabitants. The people of the overcongested regions cannot well be moved to those which are thinly peopled. Waters¹⁸ recognized this difficulty on his visit to the Philippines to investigate agricultural conditions; Bowman¹⁹ likewise has called attention to the home-loving instinct which prevents the plateau dwellers of South America from forsaking their barren habitats for the plainly visible luxuriant slopes at lower levels. Nevertheless some such migration is already occurring in the spread of Chinese coolie labor and West Indian black labor to various tropical shores.

¹⁷ Garrard Harris and others: *The West Indies as an Export Field*, *Special Agents Ser. No. 141*, Bur. of Foreign and Domestic Commerce, U. S. Dept. of Commerce, Washington, D. C., 1917.

¹⁸ H. J. Waters: *The Development of the Philippine Islands*, *Geogr. Rev.*, Vol. 5, 1918, pp. 282-292; reference on p. 288.

¹⁹ Isaiah Bowman: *The Highland Dweller of Bolivia: An Anthropogeographic Interpretation*, *Bull. Geogr. Soc. of Philadelphia*, Vol. 7, 1909, p. 160.